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(54) Title: PROCESS OF MAKING PAPERMAKERS' FABRIC

(57) Abstract

A process for producing a papermakers' fabric, wherein the paper contacting surface of the fabric is molded between two preferably heated surfaces adapted to apply contact pressure to the fabric to optimally smoothen the paper contacting surface of the fabric and egalize caliper variations in the fabric. Preferably the two surfaces are surfaces of two cooperating rolls formed in a nip press. The fabric is passed through the nip press into engagement with the heated rolls thereby molding and smoothening the surface of the fabric.

D1

P7 onward.

No: Moisture

Diffrent pressure across width.

Specific disclosure of sieve properties... void size etc

Pressure adjustment for joined fibres at joint

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PROCESS OF MAKING PAPERMAKERS' FABRIC

Field of the Invention

The present invention relates to papermakers' fabrics and especially to papermaking fabrics for the dryer or forming sections of a papermaking machine.

Background of the Invention

In the conventional fourdrinier papermaking process, a water slurry or suspension of cellulose fibers, known as the paper "stock", is fed onto the top of the upper run of a travelling endless forming belt. The forming belt provides a papermaking surface and operates as a filter to separate the cellulosic fibers from the aqueous medium from the cellulosic fibers by providing for the drainage of the aqueous medium through its mesh openings, also known as drainage holes, by vacuum means or the like located on the drainage side of the fabric.

After leaving the forming medium the somewhat self-supporting paper web is transferred to the press section of the machine and onto a press fabric, where still more of its water content is removed by passing it through a series of pressure nips formed by cooperating press rolls, these press rolls serving to compact the web as well.

Subsequently, the paper web is transferred to a dryer section where it is passed about and held in heat transfer relation with a series of heated, generally cylindrical rolls to remove still further amounts of water therefrom by evaporation. Dryer fabrics are used in the dryer section of papermaking

machinery to support the moist paper web as it encounters the heated rolls. Typically, the dryer fabric is formed into a conveyor belt-like shape and incorporates at least a woven base fabric with a smooth top surface for contacting the paper web.

The surface of the dryer fabric is determinative of the marking characteristics found on the paper. If the surface of the dryer fabric is smooth, the contact paper web will exhibit less marking, thereby resulting in high quality paper. In addition, a dryer fabric with a uniform and smooth surface provides increased contact area between the web and the heated rolls of the dryer section, thereby increasing the heat transfer between the heated rolls of the dryer section and the paper web and leading to more efficient sheet dewatering.

Thus, it has been a goal of the papermaking industry to produce dryer fabrics with a smooth and uniform paper contacting surface. The standard method for producing a dryer fabric with these characteristics has been to provide a high fabric density with weave patterns having long machine or cross machine direction floatings. Another approach has been to form the dryer fabric from flat monofilament materials in the machine direction of the fabric.

Despite the attempts of the prior art, however, knuckles formed at the crossing of the machine and cross machine direction yarns invariably render the fabric prone to contamination and marking, and prevent uniformly high heat transfer. Using flat monofilaments has improved the heat transfer between sheet and dryer roll by increasing contact area, but forms large contamination traps according to the shape of the monofilament.

Thus, various impurities become trapped within these fabrics causing highly undesirable marking characteristics.

These difficulties exist similarly in the production of forming fabrics for the forming section of the papermaking machinery. Forming fabrics, however, generally cannot be manufactured with a high fabric density since large interstices between fabric yarns must exist to ensure drainage of the aqueous medium through the fabric. Thus, surface smoothness is achieved in forming fabrics primarily by providing long floats on the paper contacting surface of the fabric, and by performing various grinding and treating methods. Invariably, however, knuckles formed on the papermaking surface cause the forming fabrics to suffer from the same deficiencies as discussed above in connection with dryer fabrics.

Summary of the Invention

Therefore, one object of the present invention is to provide an improved papermakers' fabric for use in the forming or dryer section of the papermaking machine.

Another object of this invention is to provide a papermakers' fabric having an improved surface, resulting in better sheet quality.

Yet another object of the present invention is to provide a papermakers' dryer fabric with an improved drying rate due to improved contact between the paper web and the rolls of the dryer section.

Still another object of the present invention is to provide a papermakers' dryer fabric with less opportunity for contamination due to missing knuckles.

These and other objects of the invention are achieved by a process for producing a papermakers' fabric, wherein the paper contacting surface of the fabric is molded between two preferably heated surfaces adapted to apply contact pressure to the fabric to optimally smoothen the paper contacting surface of the fabric and egalize caliper variations in the fabric. Preferably the two surfaces are the surfaces of two cooperating rolls formed in a nip press. The fabric is passed through the nip press into engagement with the heated rolls thereby molding and smoothening the surface of the fabric.

Brief Description of the Drawing

The process for manufacturing fabrics according to the present invention will be apparent from the following detailed description of the invention, along with the drawings, in which like reference numbers refer to like members throughout the various views.

FIGS. 1-3 are unity textile design charts for illustrating preferred embodiments of a dryer fabric for use in connection with the present invention.

FIGS. 4-8 are machine direction sectional views of preferred embodiments of a forming fabric for use in connection with the present invention.

FIG. 9 is a diagram of a preferred system for performing a surface molding operation on a papermaker's fabric according to the present invention.

Detailed Description of the Invention

Generally, the invention relates to the manufacturing and application of papermaker's fabrics for the forming or dryer sections of a paper machine involving the step of surface molding the fabric between heated surfaces to obtain an optimally uniform paper contacting surface.

The fabrics manufactured according to the present invention, as do most papermakers' fabrics, incorporate a woven fabric, being either single or multilayer, e.g. monoplane, duplex, X-weave, triple weft or triplex. The weave patterns and materials for the fabric will be selected according to criteria such as smoothness of the fabric surface against the sheet side and/or wear resistance against the rolls.

FIGS. 1-3 are design charts which illustrate preferred weave patterns for dryer fabrics which are particularly useful in connection with the present invention. In these figures, Arabic numerals 1-13 denote cross machine direction yarns, and numerals 13-18 denote machine direction yarns. The symbols "X" denote locations where cross machine direction yarns are positioned over machine direction yarns, giving long machine direction floats. FIGS. 4-8 are machine direction sectional views of preferred forming fabrics for us in connection with the present invention wherein the machine direction yarns 19-20 are interwoven with cross machine direction yarns 21-24.

As can be seen, the preferred weaves include long machine direction yarn floats, i.e. machine direction yarns which travel over two or more successive cross machine direction yarns without diving back down into the fabric. FIGS. 1-8 represent preferred, but not limiting weave patterns for dryer and forming fabrics. The fabrics depicted in FIGS. 1-3 demonstrate preferred weaves on either eight or twelve shaft. Different weave patterns are used to match different permeability ranges for the dryer fabrics according to their application in the warm-up, the main evaporation zone, or the cooling zone of the dryer. Similarly, different weave patterns for the forming fabrics may be used according to predetermined criteria.

The conventional yarns utilized in dryer and forming fabrics of the present invention will vary, depending upon the desired properties of the fabric. Round shaped polyester-monofilaments with diameters of 0.3mm to 0.6mm represent the preferred material for the standard dryer fabric. Polyester and polyamide monofilaments with diameter of 0.08mm to 0.4mm represent the preferred material for standard forming fabrics. Nonetheless, the yarns may be round, elliptic, or flat, and may be multifilament yarns, monofilament yarns, twisted multifilament and/or monofilament yarns, spun yarns or any combination of the above. It is within the skill of those practicing in the relevant art to select a yarn type, depending on the purpose of the fabric, to utilize with the concepts of the present invention.

Yarns selected for use in each layer of the woven dryer or forming fabric of the present invention may be those commonly

used in dryer fabric or forming fabric base fabric layers. For example, the yarns could be ryton, peek, cotton, wool, polypropylenes, polyesters, aramids or polyamides or combinations of these materials. Again, one skilled in the art will select a yarn material according to the particular application of the final composite fabric.

After weaving and joining, the dryer or forming fabrics of the present invention are subjected to a finishing process. Referring to FIG. 9, during the preferred finishing process, the fabric 27 is surface smoothened by molding between two rolls 25, 26 configured in a nip press. At least one, preferably both rolls 25,26 are heated by either a steam or oil source (not shown). Also, in the preferred embodiment the rolls 25, 26 are swimming rolls which provide uniform pressure and heat transfer, giving the fabric a uniformly molded surface. In the molding process, the fabric 27 is warmed on a heated roll(s) 25,26, passed through the nip press formed by the rolls, and cooled. This process is iteratively performed while continuously checking caliper, permeability and imprints of the fabric surface to meet desired specifications for the fabric.

Different fabric designs require specific molding procedures which differ in temperature, loading, dwell time, passes, etc. to obtain optimum surface smoothness. However, one pass of the fabric between two rolls configured in a nip press at a temperature of 150 °C, at a speed of 0.7 m/min and a loading of 20-150 kp/cm² represents a useful starting point. Nonetheless, the optimum parameters will always depend on the type of fabric used and the desired criteria for the final fabric. It has been

found, however, that the temperature used for the process is typically between about 130 °C and about 240 °C. The speed at which the fabric is passed through the rolls varies depending on the design between 0.3 and 10 m/min. Likewise, the specific loading used for the molding process varies between about 20 kp/cm² and 150 kp/cm². Typically, the fabric must be passed through the rolls up to 10 times to meet the desired fabric specifications.

In addition, although the preferred embodiment involves the use of two heated rolls 25,26 it is also possible to heat only one roll 25 or to use only one roll to press the fabric against a flat plate (not shown) with either or both of the surfaces being heated. Other variations are also possible as long as contact pressure and heat are applied to the fabric between two surfaces.

Thus, the described process provides a molded fabric surface having optimum uniformity. In addition, caliper variations which exist in prior art fabrics are egalized down to the micro-scale and prominent fabric knuckles are eliminated. Thus, a fabric having a molded surface according to the present invention provides improved paper quality, less contamination, and improved drying rates due to improved sheet/roll contact in the case of dryer fabrics.

While the invention has been particularly shown and described with reference to the aforementioned embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention. Thus, any

modification of the shape, configuration and composition of the elements comprising the invention is within the scope of the present invention. It is to be further understood that the instant invention is by no means limited to the particular constructions or procedures herein disclosed and/or shown in the drawings, but also comprises any modifications or equivalents within the scope of the claims.

What is claimed is:

1. A process for manufacturing a papermakers forming fabric or dryer fabric comprising:

providing a woven fabric of interwoven cross machine direction and machine direction yarns; and

molding a paper contacting surface of said fabric by passing said fabric between two surfaces adapted to apply contact pressure to said fabric, at least one of said two surfaces being a heated surface.

2. The process according to claim 1, wherein at least one of said two surfaces comprises a surface of a roll.

3. The process according to claim 2, wherein said roll is a swimming roll.

4. The process according to claim 1, wherein said two surfaces comprise surfaces of two cooperating rolls configured in a nip press, and said paper making surface is molded by passing said fabric through said nip press.

5. The process according to claim 1 wherein said paper contacting surface comprises long machine direction floats which cross over at least two of said cross machine direction yarns successively before descending between others of said cross machine direction yarns.

6. The process according to claim 1, wherein said at least one of said two surfaces is heated to a temperature between about 130 °C and 240 °C.

7. The process according to claim 1, wherein said fabric is passed between said two surfaces at a speed between about 0.3 m/min and 10 m/min.

8. The process according to claim 1, wherein said fabric is passed between said two surfaces at a specific loading between about 20 kp/cm² and 150 kp/cm².

9. The process according to claim 1, wherein said two surfaces comprise surfaces of two cooperating rolls configured in a nip press, said rolls being heated to about 150 °C, and wherein said fabric is passed through said nip press at a speed of about 0.7 m/min.

10. A process for manufacturing a papermakers forming fabric or dryer fabric comprising the steps of:

(1) providing a woven fabric of interwoven cross machine direction and machine direction yarns; and

(2) molding a paper contacting surface of said fabric by passing said fabric between two surfaces adapted to apply contact pressure to said fabric, at least one of said two surfaces being a heated surface;

(3) cooling said fabric;

(4) checking said fabric for compliance with desired specifications; and

(5) iteratively performing steps (2) through (4) until said fabric complies with said desired specifications.

11. A papermakers fabric manufactured according to the process of claim 1.

12. A papermakers fabric manufactured according to the process of claim 10.

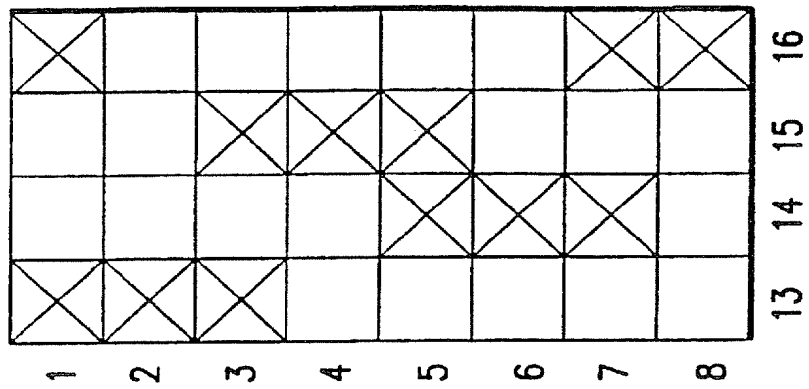

FIG.3

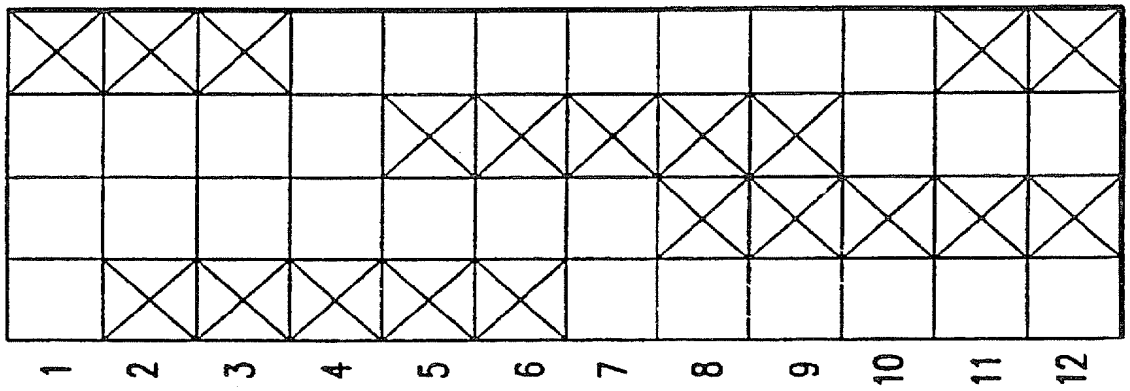

FIG.2

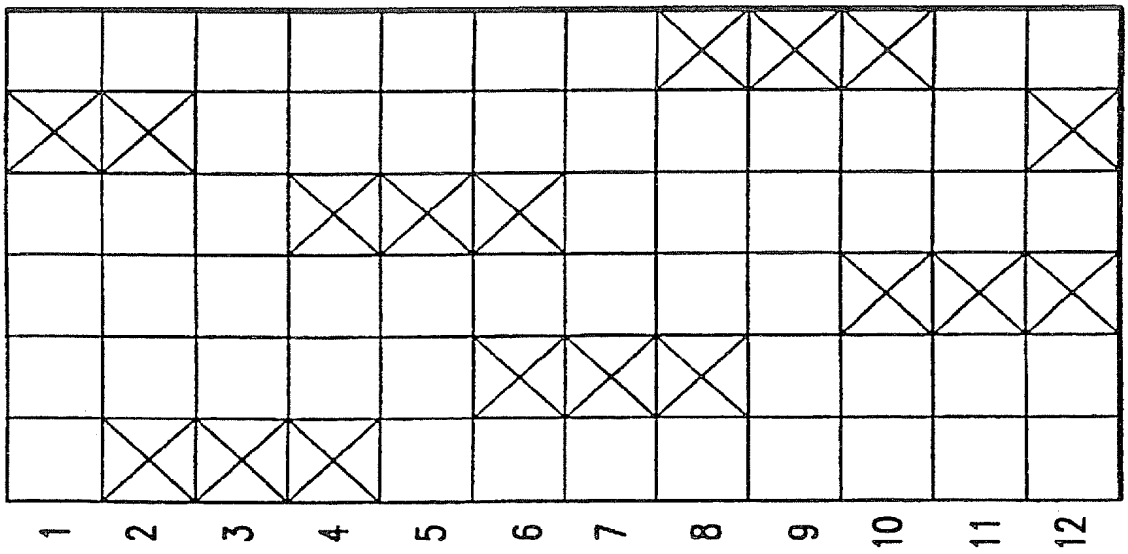

FIG.1

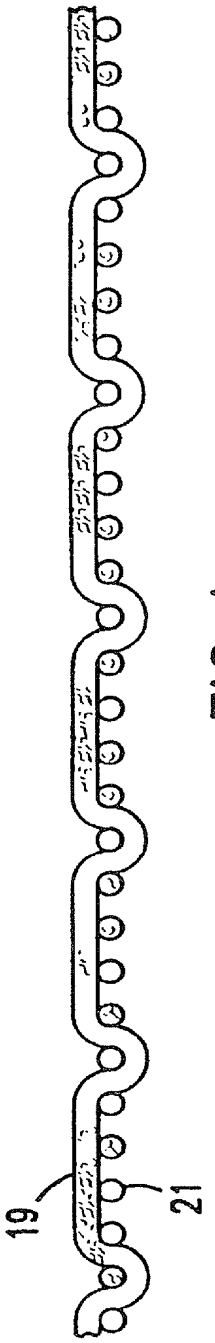

FIG. 4

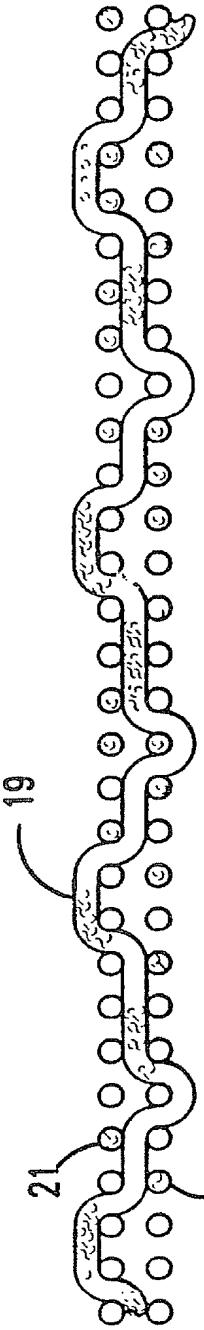

FIG. 5

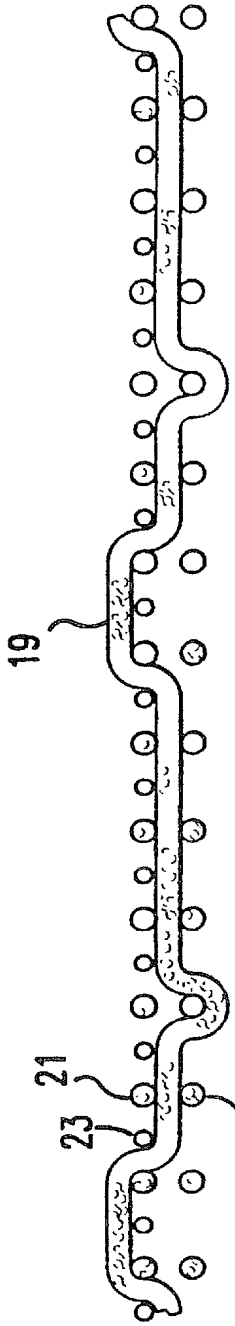

FIG. 6

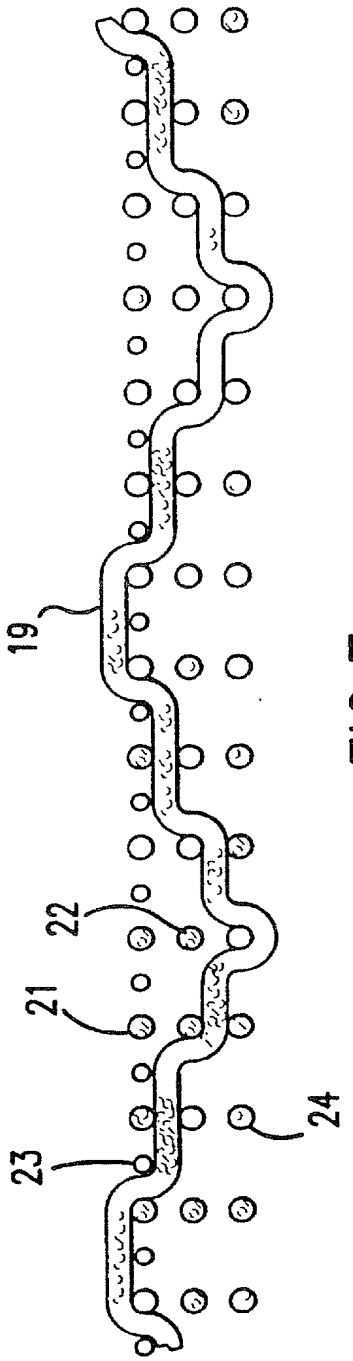

FIG.7

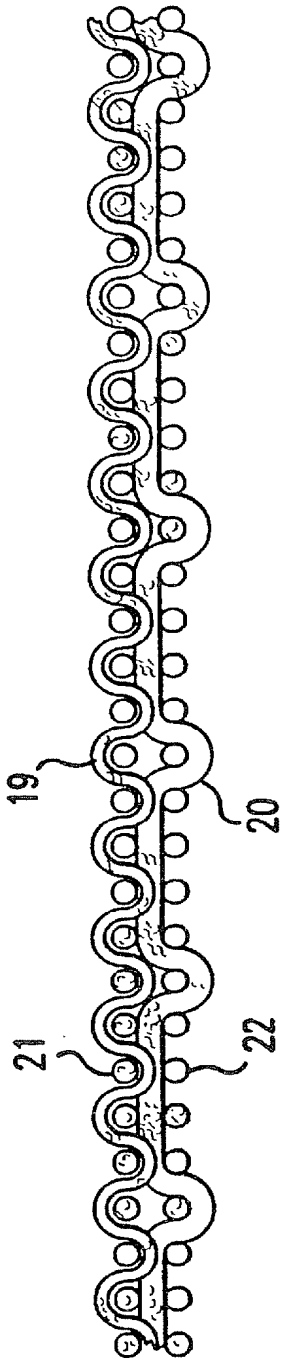

FIG.8

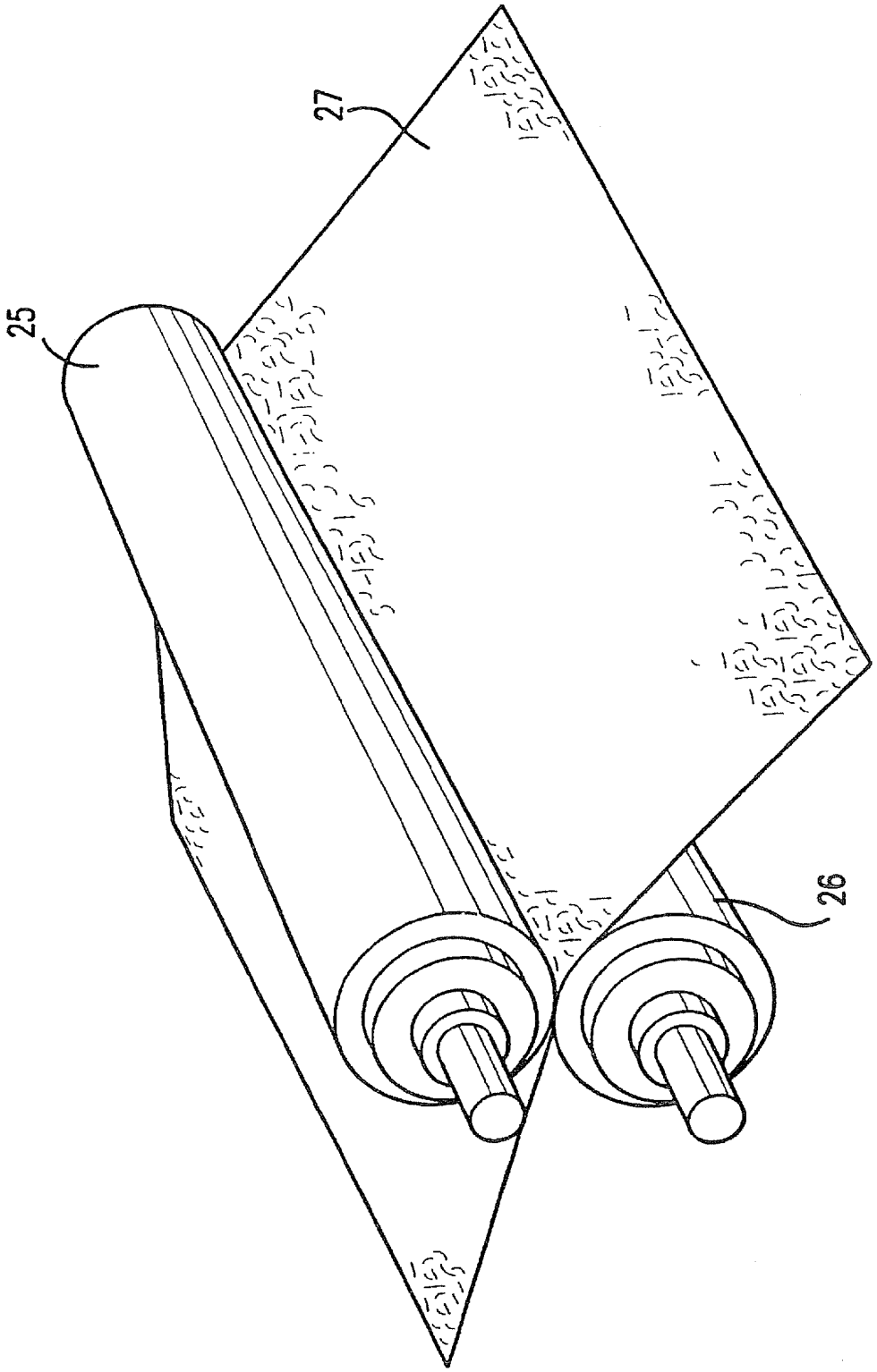

FIG.9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/11086

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B29C 59/04
US CL :264/40.1, 280, 284; 428/224, 225
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 264/40.1, 175, 280, 284; 428/224, 225

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,407,737 A (W. HALTERBECK ET AL) 18 April 1995 (18.04.95), column 1, lines 5-34 and column 2, lines 12-51.	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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